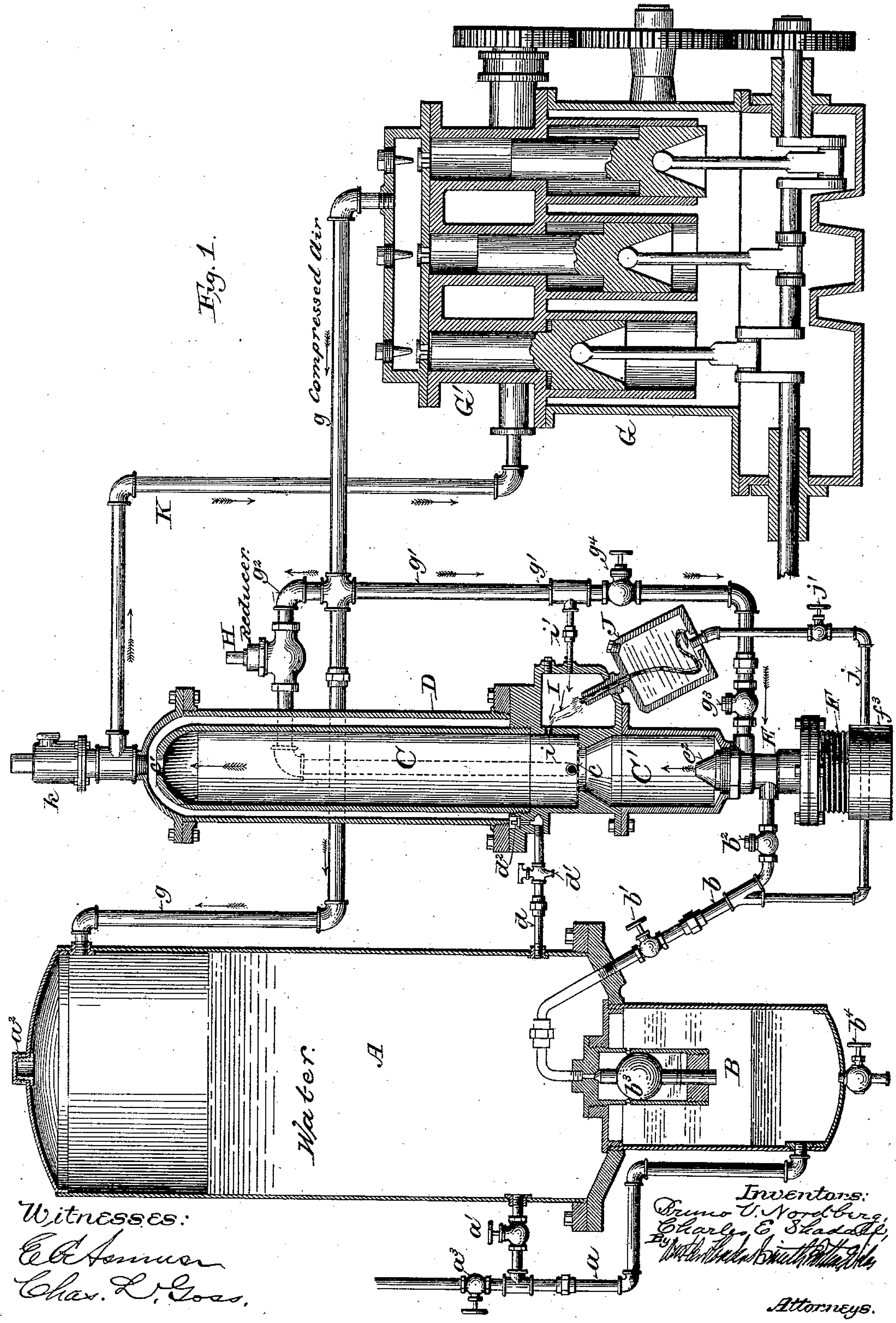
(No Model.) 3 Sheets—Sheet 1.

B. V. NORDBERG & C. E. SHADALL.

APPARATUS FOR PRODUCING MOTIVE POWER.

No. 543,501. Patented July 30, 1895.



Witnesses:
E. A. Asmuson
Chas. L. Goss.

Inventors:
Bruno V. Nordberg,
Charles E. Shadall,
By [signature]
Attorneys.

(No Model.) 3 Sheets—Sheet 2.

B. V. NORDBERG & C. E. SHADALL.

APPARATUS FOR PRODUCING MOTIVE POWER.

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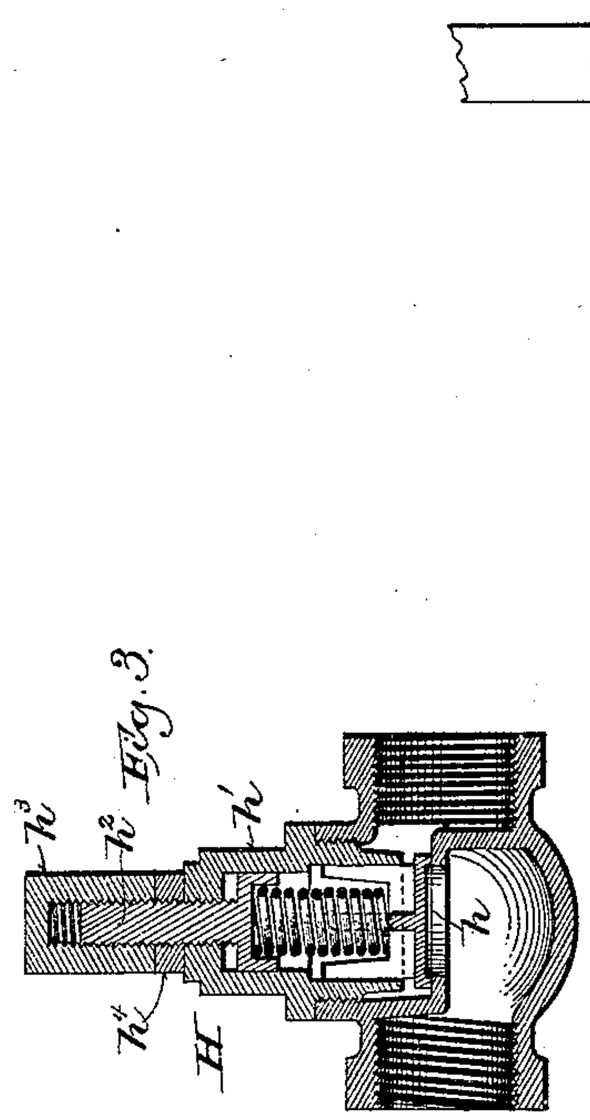

Fig. 3.

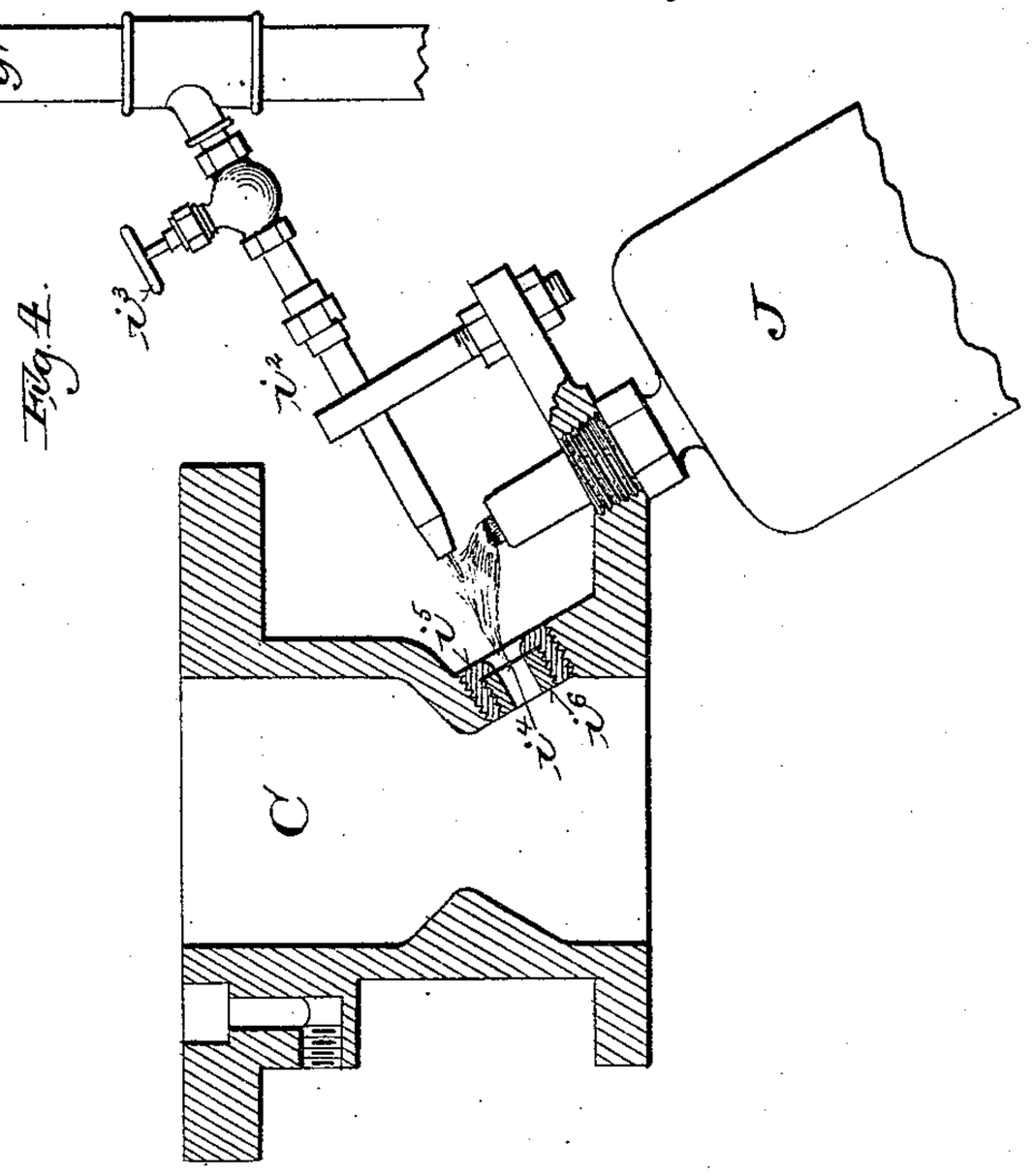

Fig. 4.

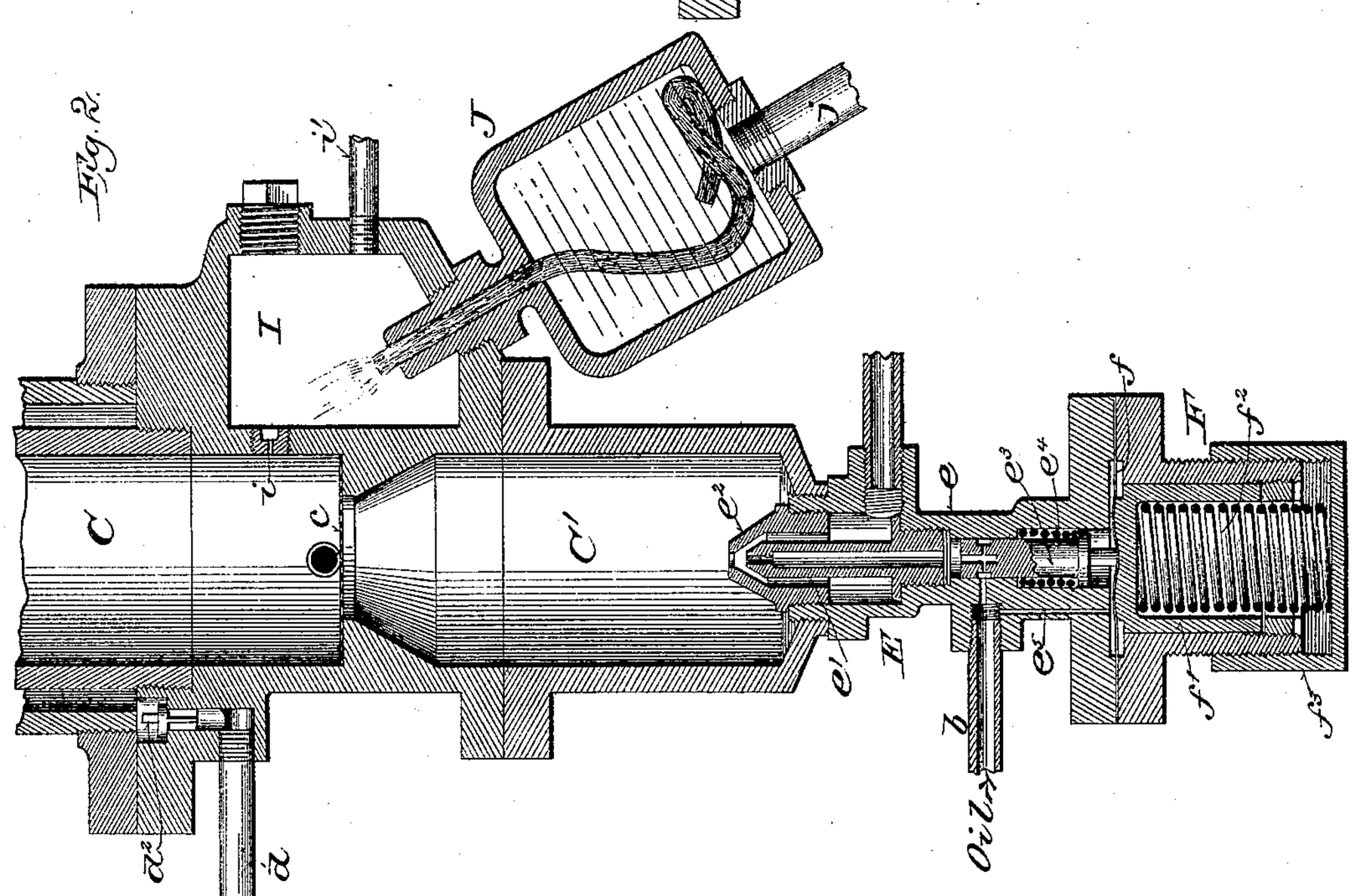

Fig. 2.

Witnesses:
C. C. Ammen
Chas. L. Goss.

Inventors
Bruno V. Nordberg
Charles E. Shadall,
By Wright Brown Quinby & Woodard
Attorneys.

(No Model.) 3 Sheets—Sheet 3.

B. V. NORDBERG & C. E. SHADALL.

APPARATUS FOR PRODUCING MOTIVE POWER.

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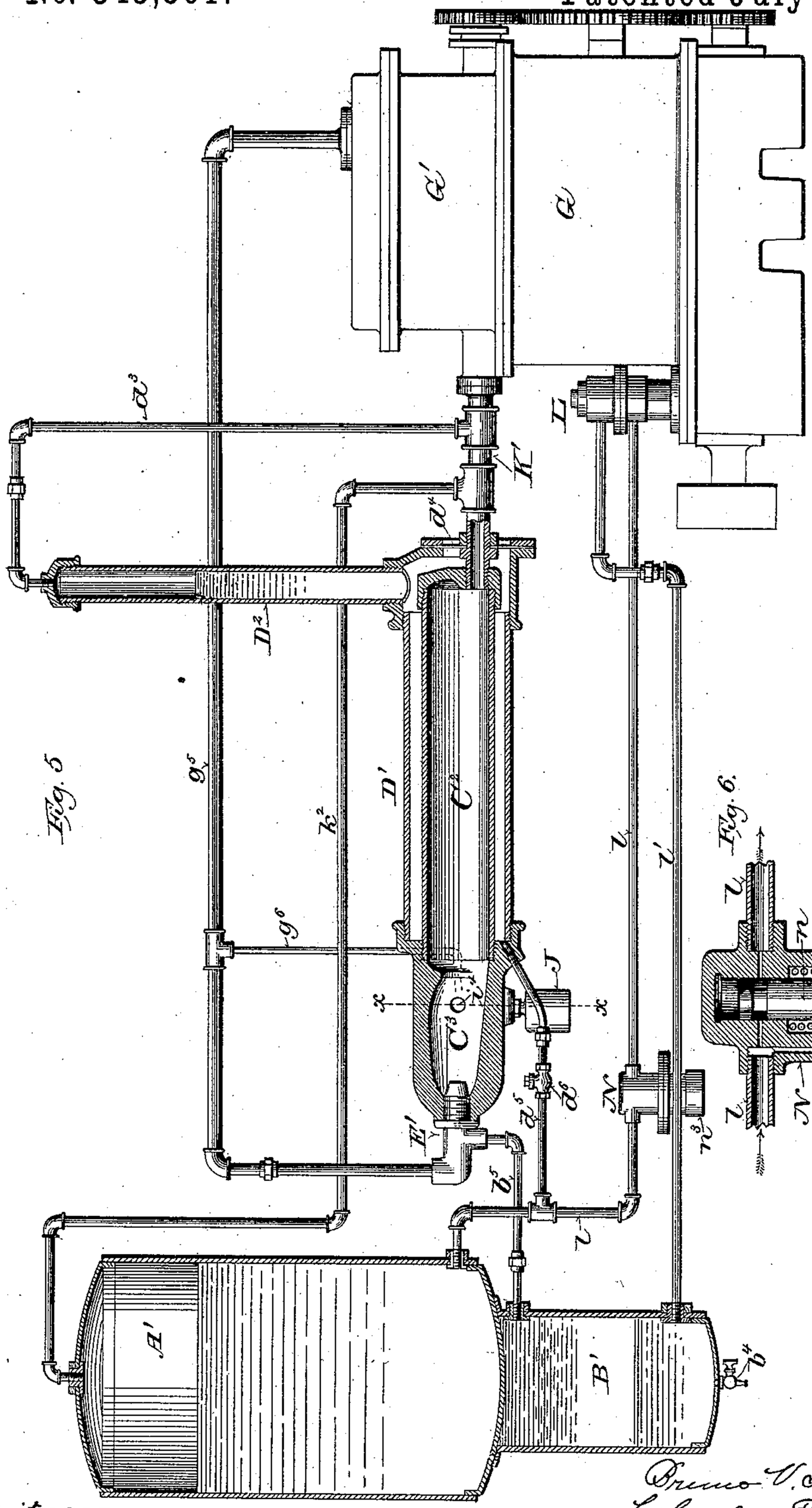

Fig. 5.

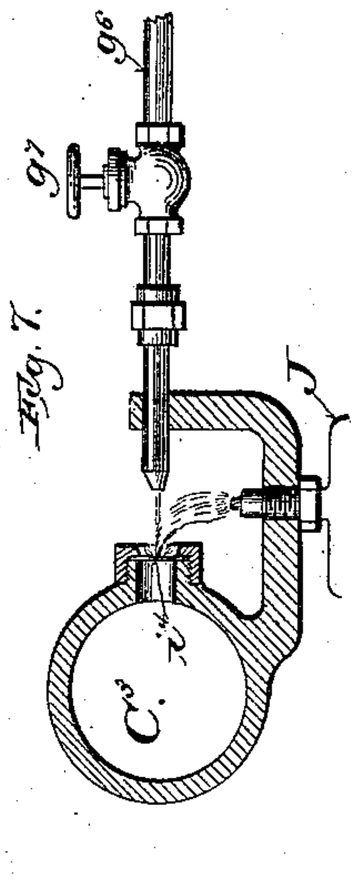

Fig. 7.

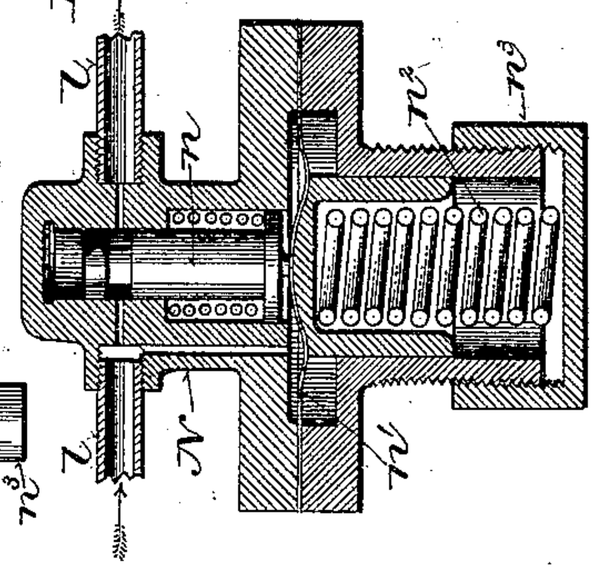

Fig. 6.

Witnesses:
E. C. Tanner
Chas. L. Goss.

Inventors
Bruno V. Nordberg,
Charles E. Shadall,
By Wright Brown Quinby & Potter
Attorneys.

UNITED STATES PATENT OFFICE.

BRUNO V. NORDBERG AND CHARLES E. SHADALL, OF MILWAUKEE, WISCONSIN, ASSIGNORS TO THE BRUNO NORDBERG COMPANY, OF SAME PLACE.

APPARATUS FOR PRODUCING MOTIVE POWER.

SPECIFICATION forming part of Letters Patent No. 543,501, dated July 30, 1895.

Application filed August 11, 1890. Serial No. 361,680. (No model.)

To all whom it may concern:

Be it known that we, BRUNO V. NORDBERG and CHARLES E. SHADALL, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Apparatus for Producing Motive Power; and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The main objects of our invention are to produce a driving medium for engines by the continuous ignition of oil or the vapor of oil under pressure; to apply the medium thus produced in the manner of steam to engines of the usual or any suitable type, whereby the speed of the engine may be increased, diminished, and controlled and its movement reversed, as in the case of ordinary steam-engines, and to utilize in connection with the gaseous driving medium the force of the heat absorbed in keeping down the temperature of the chamber or retort in which the gas is produced.

It consists of certain novel features in the construction and arrangement of the component parts of the apparatus, as hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings like letters designate the same parts in the several figures.

Figure 1 is a vertical sectional view of an apparatus embodying our invention. Fig. 2 is a sectional view, on an enlarged scale, of a portion of the gas-generating chamber, the atomizer, and automatic feed-regulator through which the oil is introduced to said chamber and of the igniting device. Fig. 3 is a similar view of a reducing-valve by which a differential pressure is maintained in the gas-generating chamber and the oil-tank. Fig. 4 is a detail view of a modification of the igniting device. Fig. 5 is a general sectional view of a modification of the apparatus. Fig. 6 is a detail view of a modified form of regulating-valve for controlling the supply of oil to the gas-generating chamber; and Fig. 7 is a cross-section taken on the line x x, Fig. 5.

Referring to Fig. 1, A represents a closed water-tank; B, an oil-reservoir connected near the bottom with the lower part of the water-tank by a pipe a, which is provided with a valve a'.

C represents a combustion-chamber of any suitable form and material capable of withstanding the necessary pressure. It is placed in an upright or vertical position and surrounded by a casing or jacket D, which is connected at its lower end with the lower part of the water-tank A by a pipe d, which is provided with a cock d'. A check-valve d^2 is placed in the passage, through which water enters said jacket to prevent a back-flow into tank A.

At the lower end the chamber C is attached to, or extended to form, a mixing-chamber C', which communicates with chamber C at its lower end, preferably through a contracted aperture, in which is placed a screen c. In an aperture in the lower end of chamber C' is inserted an atomizer E, as shown in Fig. 2, consisting of an outer shell or casing e, a nozzle e', having a contracted aperture at the upper end, and a conical cap e^2, screwed into said shell or casing over the end of the nozzle e' and having a contracted aperture in line with the aperture in said nozzle. A pipe b connects the atomizer E below the nozzle e' with the upper part of the oil-reservoir B. This pipe is provided with an ordinary globe-valve b' and a check-valve b^2, and the opening from the oil-reservoir into said pipe is controlled by a float-valve b^3, which is made of such buoyancy that it will float upon water but not upon oil. The casing e of the atomizer is extended below the nozzle e', and a valve e^3 is inserted therein, as shown in Fig. 2, to control the communication between said nozzle and the oil-pipe b.

The lower end of the shell e is flanged, and to it is attached a flanged sleeve F, with a flexible diaphragm f interposed between them and bearing at the upper side against a projection on valve e^3. In the sleeve F is inserted a piston f', which bears against the under side of the diaphragm f, and is held

against said diaphragm with a regulated pressure by a spring f^2, which bears at its opposite end against an adjustable cap f^3, screwed upon the sleeve F. A spring inserted in a recess around valve e^3 in the shell e and bearing at one end against a flange on the lower end of said valve and at the opposite end against a shoulder in said shell holds the valve down against the diaphragm f. A passage e^5 in the shell e establishes a communication between the oil-pipe b and the space above the diaphragm f.

The water-tank A is furnished at the top with a removable cap a^2, or other suitable means for supplying the same with water, and the oil-reservoir B is provided at the bottom with a waste-cock b^4 for the purpose of drawing off the water in said reservoir when it is desired to refill the same with oil. For the purpose of filling said reservoir B with oil the pipe a may be extended above its connection with the water-tank A and provided with a valve a^3, which is ordinarily closed, while communication is established between the tank A and reservoir B by opening the valve a'.

G represents an engine in connection with which an air-pump G′ is provided. A force-pipe g leads from the air-pump to the upper portion of the water-tank A and by a branch g' into the space between the shell e and the nozzle e' of the atomizer and through a branch g^2 into the lower part of chamber C. The branch g' is provided with a check-valve g^3, by which a back flow or pressure is prevented, and with an ordinary globe cut-off valve g^4. The branch g^2 is provided with a reducing-valve H, (shown in detail in Fig. 3,) and consists of a suitable valve-case provided with a seat similar to an ordinary globe-valve, a wing-valve h, adapted to said seat, a screw-cap h', inserted in an aperture in the valve-case over the valve-seat therein and serving as a guide for the valve h, a spring bearing at one end against said valve and at the other end against an adjusting-screw h^2, projecting through a threaded aperture in said cap, and a cap h^3 and jam-nut h^4, placed upon said screw and affording means for turning the same in or out of the cap h', for the purpose of adjusting the tension of the spring. By means of this valve h a higher pressure is produced in the water-tank A than in the combustion-chamber, and by means of the difference of pressure the water is forced into the reservoir B and the oil driven therefrom through the pipe b into the chamber C′.

On one side of the chamber C, at its lower end, a chamber I is formed, into which is inserted the stem or burner of a lamp J. This lamp may be supplied with oil through a pipe j, connecting it with the oil-pipe b, the supply being controlled by a valve j'. Chamber I communicates with chamber C through a small aperture i, and a little below and on the opposite side it is connected by a pipe i' with the air-force pipe g', the aperture i and the pipe i' being arranged to produce a draft through chamber I, which will carry the flame of lamp J through the aperture i into the chamber C, so as to keep the oil-vapor therein constantly ignited.

The combustion-chamber C communicates at its upper end through an aperture c' with the space inclosed by the jacket D, and a pipe K leads out of the upper end of said jacket adjacent to the aperture c' to the engine G. k represents an ordinary safety-valve attached to the top of the jacket D.

Our improved apparatus operates as follows: Reservoir B having been filled with oil and the tank A supplied with water, an air-pressure sufficient to start the apparatus is produced in tank A by a hand-pump or other convenient means. Water is forced through the pipe a into the lower part of reservoir B, thereby forcing a small stream or jet of oil into the atomizer through the nozzle e'. Air being forced at the same time through the pipe g' passes through the annular space between the shell e and nozzle e' and mingles with the oil in cap e^2, from which it issues in a fine spray into the mixing-chamber C′. As it passes upward into the chamber C it comes in contact with the flame of lamp J, carried by the air-blast from pipe i' through the aperture i, and is ignited thereby and converted into a gas of much greater volume than the mingled air and oil-vapor. Whatever air is not required to supply the atomizer and the water-tank A passes through the reducing-valve H in pipe g^2 into the lower part of chamber C, mingling with the vapor entering said chamber from chamber C′ and supplying any deficiency of oxygen for its complete combustion, and whatever is not so consumed being heated and expanded by the hot gases and mingling therewith to produce the driving medium. In this manner the required pressure for driving an engine is created and maintained in the chamber C. The reducing-valve H maintains the required difference in pressure in the tank A and combustion-chamber C to cause the oil to be forced from the oil-reservoir B into the combustion-chamber as it is needed. The pressure in chamber C is regulated by adjusting the tension of the spring f^2, controlling the valve e^3, by which the flow of oil from pipe b into the nozzle of the atomizer is regulated. When the pressure in tank A, and consequently in the other portions of the apparatus connected therewith, rises above a certain point, it is communicated through the oil in passage e^5 to the upper side of diaphragm f, and compressing the spring f^2 permits the valve e^3 to descend, thereby diminishing the flow of oil for the time being into the atomizer, and thence into the combustion-chamber. The supply of material from which the driving medium is produced being thus diminished the pressure in the combustion-chamber falls, and a decrease in pressure results throughout the apparatus, and consequently upon the diaphragm f,

which, being thus relieved of pressure, permits the spring f^2 to raise the valve e^3, thereby re-establishing full communication between the pipe b and the nozzle of the atomizer.

By the constant combustion of the vapor and the consequent generation of gas under pressure in chamber C its walls become intensely heated, and to keep down their temperature a sufficient supply of water is introduced through pipe d to fill or partially fill the jacket D. The water thus employed to keep down the temperature of the combustion-chamber is converted into steam which mingles with the hot gases issuing from the opening in the upper end of chamber C and is superheated by such gases, being utilized with them as a part of the actuating medium for driving the engine. The combined gases, air, and steam thus produced are conducted through the pipe K to the engine G, to the driving of which they are applied in the same manner as steam.

Various modifications may be made in the construction and arrangement of our apparatus and of its several details without affecting its mode of operation or departing from the spirt of our invention.

Referring to Fig. 4, illustrating a modification of the igniting device, an air-jet pipe i^2, provided with a valve i^3, is arranged to carry the flame of the lamp J against a thin platinum disk i^4 and heat the same to incandescence. This disk is held in an aperture in the wall of the combustion-chamber C, between screw-threaded rings i^5 and i^6, screwed one into the other and the outer into the aperture in said chamber, suitable non-conducting material being interposed between said disk and rings to prevent the conduction of heat from said disk. The wall of the chamber C, in which said disk is inserted, is preferably inclined inwardly, as shown, so that the jet of oil-vapor from the atomizer will be more directly projected against it.

Various other devices may be employed for the ignition of the oil-vapor, any device which will maintain constant combustion in the chamber C being sufficient.

Referring to Fig. 5, showing a modification of the apparatus in which the combustion-chamber is placed horizontally and the oil is fed thereto by a pump which forces water into the oil-reservoir, A′ represents the water-tank; B′, the oil-reservoir; C^2, the combustion-chamber, and C^3 a chamber communicating therewith, into which the mingled oil, vapor, and air are fed. A pipe K′ connects the opposite end of the combustion-chamber with the engine and a pipe k^2 connects the pipe K′ or combustion-chamber with the upper part of the water-tank A′, so as to maintain an equal pressure in the combustion-chamber and water-tank. Instead of employing a differential pressure in the water-tank and combustion-chamber to force the oil into the latter, we provide a pump L or other suitable forcing device and connect the same by the suction-pipe l with the lower portion of the water-tank A′ and by the force-pipe l' with the lower part of the oil-reservoir B′. In the suction-pipe l is placed an automatic regulating-valve N. (Shown in detail in Fig. 6 and similar to that shown in Fig. 2.) This valve consists of a plunger n, bearing at one end upon a diaphragm n', which is exposed on the same side to the pressure produced in the suction pipe l, and of a spring n^2, bearing against the opposite side of said diaphragm, and an adjusting nut or cap n^3, by which the tension of the spring is regulated and the rate of flow through the pipe l is controlled. The pipe b^5 connects the upper part of the oil-reservoir B′ with an atomizer E′ inserted in the end of the chamber C^3 opposite the combustion-chamber C^2, and a pipe g^5 connects said atomizer with the air-pump G′. A branch pipe g^6 of the pipe g^5, provided with a regulating-valve g^7, as shown in Fig. 7, supplies the air jet or blast, by which the flame of a lamp J is carried against the disk i^4 of the igniting device located in the side of chamber C^3. D′ represents a jacket surrounding the combustion-chamber C^2. It is connected at one end by a pipe d^5, having a regulating-valve d^6, with the suction-pipe l or water-tank A′. At the opposite end this jacket is provided on the upper side with a stand-pipe d^2, by means of which the jacket is kept constantly filled with water. A pipe d^3 connects the top of the stand-pipe with the pipe K′.

To provide for the unequal expansion and contraction of the combustion-chamber C^2 and its jacket D′, we form the head of the jacket through which the pipe K′ passes of a flexible diaphragm d^4, which permits of such expansion or contraction without injury to the said chamber or jacket, and without affecting the joints of the eduction-pipe K′ therewith. The combustion-chambers may if desired be filled or partially filled with any suitable refractory material, which would be heated to incandescence and insure the perfect and continuous combustion of the oil-vapor and at the same time prevent any coarse impurities from passing into the eduction-pipe. The operation of this form of the apparatus is similar to that previously described, and will be readily understood from the foregoing description of its construction and arrangement.

In places furnished with a water-supply system the water-tank of the apparatus may be dispensed with and the oil-reservoir directly connected with such system, a pump being employed to produce the necessary pressure for feeding the oil into the apparatus when the pressure of the water-mains is insufficient for the purpose.

By employing steam with the hot gases of the driving medium, as hereinbefore explained, the piston and cylinder of the engine are lubricated and preserved, and the difficult action and rapid wear and deterioration

of the parts mentioned, which would otherwise result from the use of the dry hot gases alone, are thus avoided.

We claim—

1. In apparatus for producing an actuating medium for engines, the combination of a closed water tank, a closed oil reservoir having a connection between the lower part thereof and the lower part of said tank, a closed combustion chamber connected with the upper part of the oil reservoir, and a pump connected with said water tank, substantially as and for the purposes set forth.

2. In apparatus for producing an actuating medium for engines, the combination of a closed water tank, a closed oil reservoir connected therewith, a combustion chamber connected with the oil reservoir, and a force pump connected with the water tank and arranged to produce and maintain a constant pressure thereon, whereby water is forced therefrom into the lower part of the oil reservoir, and oil is fed from the upper part of said reservoir into the combustion chamber, substantially as and for the purposes set forth.

3. In apparatus for producing an actuating medium for engines, the combination of an oil reservoir, a combustion chamber connected with said reservoir, and an igniting device consisting of a chamber provided with a lamp or burner and communicating through an opening with said combustion chamber in proximity with its oil connection, and an air blast device connected with said lamp or burner chamber, substantially as and for the purposes set forth.

4. In apparatus for producing a driving medium for engines, the combination of a water tank, an oil reservoir connected therewith, a combustion chamber connected with said oil reservoir, a pump connected with said water tank and with the combustion chamber, and a reducing valve in the connection with the combustion chamber, whereby a greater pressure is maintained in the water tank than in the combustion chamber, and oil is fed to the latter by such differential pressure, substantially as and for the purposes set forth.

5. In apparatus for producing an actuating medium for engines, the combination of a combustion chamber, an oil reservoir connected therewith, a pump arranged to force oil from said reservoir into the combustion chamber and having a connection with said combustion chamber, and a reducing valve in the latter connection, whereby a differential pressure is maintained in the oil reservoir and combustion chamber, substantially as and for the purposes set forth.

6. In apparatus for producing an actuating medium for engines, the combination of a water tank, an oil reservoir having a connection therewith, a combustion chamber having a connection with the upper part of said oil reservoir, a float buoyant in water but not in oil, controlling communication from the oil reservoir to the combustion chamber, substantially as and for the purposes set forth.

7. In apparatus for producing an actuating medium for engines, the combination of a closed water tank, an oil reservoir connected therewith, a combustion chamber connected with said oil reservoir, an atomizer through which oil is injected into said chamber, an air pump having separate connections with said water tank, atomizer and combustion chamber, a reducing valve placed in the connection with the combustion chamber, and an automatic regulating valve controlling the supply of oil to the combustion chamber, substantially as and for the purposes set forth.

In testimony that we claim the foregoing as our own we affix our signatures in presence of two witnesses.

BRUNO V. NORDBERG.
CHAS. E. SHADALL.

Witnesses:
CHAS. L. GOSS,
E. C. ASMUS.